**Abstract**

Nowadays, Human consumption load to massive industrial sector manufacturing. Pesticides are one of the most toxic chemicals widely used to increase agricultural production. These compounds present several threats to the environment. The photocatalytic degradation of difenoconazole (DFL) was carried out via Photo-Fenton process using synthesized α-Fe₂O₃ nanoparticles. The α-Fe₂O₃ was prepared using hydrothermal approach at 120°C with ferrous chloride and sodium hydroxide reagents. The sample was characterized by X-ray diffraction (XRD), scanning electron microscopes (SEM), transmission electron microscopes (TEM) and Raman analysis. Average crystallite size has been recorded to be 27 nm and the surface area was found to be S₆$_{BET}$=81.8 m²/g. DFL removal has been tested under diverse systems: UV photolysis, UV/α-Fe₂O₃, UV/α-Fe₂O₃ Fenton and Photo-Fenton process. The kinetic has been monitored using High Performance Liquid Chromatography (HPLC). All degradation tests were achieved at 254 nm using UV lamp. An optimization of reaction conditions (pH, oxidant concentration, and catalyst dosage) were performed. A previous work, it was already demonstrated that Photo-Fenton process (UV/α-Fe₂O₃/H₂O₂) as most effective for DFL removal. The optimal catalyst dose of α-Fe₂O₃ for high removal rate is about 0.15 g/L at initial solution pH. The mineralization efficiency attained 83.67%. The oxidation kinetics of DFL was recorded to agree with the pseudo-first-order kinetic model. Finally, a possible mechanism pathway was proposed based on detected intermediates using gas chromatography-mass spectrometry (GC-MS) analysis.

**Introduction**

Over the last decade, the world’s priority was to meet human food needs. Pesticides are chemical compounds created to deal with phytopathology for human survival exigency. They are classified depending on their principal target and chemical structure[1]. Insecticides, herbicides, fungicides, and nematicides are a broad array of products utilized every day in crop fields worldwide. Certainly, the agricultural production has been guaranteed, but in return, the treatment rate with those compounds exceeded the threshold to the contamination stage. Since the world has become more environmentally conscious, the governments have been oriented towards enormous investments in green technologies. The conventional processes of wastewater treatments represented in the Physio-chemical and biological techniques are still ineffective in removing persistent pollutants[2]. Therefore, a vigorous attempt has been made to find new and alternative processes that are economic, widespread, renewable and have no impact on environment[3]. Advanced oxidation processes (AOPs) have been confirmed as promising technologies[4].

In the present work, we reported the synthesis of α-Fe₂O₃ nanoparticles with the hydrothermal method at 120°C. It manifested as eco-friendly and economical approach with low-cost reagents and a simple fabrication method. The sample properties were characterized using a range of analytical techniques XRD, TEM, SEM, and RAMAN analysis. The potential photocatalytic activity of α-Fe₂O₃ nanoparticles under UV light source was investigated by monitoring the degradation of difenoconazole (DFL). Also, a tandem of discoupled class, widely used for fruit, vegetables, and cereal disease control. It rendered a toxic product in an excessed dose; a deterioration of environment and human health is expected in long term usage. A possible photocatalytic mechanism pathway was proposed based on the detection of intermediate compounds and the enhancement of DFL photocatalytic degradation.

**Results & Discussion**

In the inorganic photocatalyst degradation was performed under different system direct photolysis, UV/α-Fe₂O₃, UV/α-Fe₂O₃ Fenton, and Photo-Fenton process. As shown, in Fig.4, Photo-Fenton process observed to be the most effective over other methods, achieving a total removal nearly within 20 min. The optimum pH that manifested an effective treatment was pH-7. Hence, the impact of H₂O₂ concentration was varied and α-Fe₂O₃ was found the ideal concentration for Photo-Fenton reaction 0.5-3.5 g/L of catalyst improves an impressive efficiency compared to high or low catalyst dosages.

**Materials & Methods**

- **Substrate**: Difenoconazole (fungicide).
- **Synthesis protocol of α-Fe₂O₃**: The samples were extracted in dichloromethane solution after 60 min of photolysis reaction. The intermediates were followed using gas chromatography coupled with mass spectrometry (GC-MS) analysis system.
- **Characterization of synthesized α-Fe₂O₃**
  - The optical property of the synthesized photocatalyst: the sample Bandgap has been recorded using the Tauc equation, the specific optical edge of the photocatalyst $E_{g}$ = 2.46 eV. The XRD spectra shows a strong pure phase. The sample composed of crystals with semi-spherical shape. The green size of the monoclinic nanoparticles is about 72 nm.

**Mechanism & Mineralization**

**Results (a) photodegradation of DFL under different system (b) pH effect (c) hydrogen peroxide effect (d) effect of catalyst dosage**

**Mechanism (a) proposed transformation pathway**

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**References**


